FRONTLINE

The Earthquake is Coming

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FRONTLINE #502

The Earthquake is Coming

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Introduction

NARRATOR
Tonight, on FRONTLINE...it will be a natural disaster which could devastate the entire country.

RICHARD EISNER
You know, inevitably, we're going to have recurrances of major earthquakes in the bay area and that people are going to be killed.

NARRATOR
Scientists predict a major catastophic earthquake in California in the next twenty years. Can the U.S. prepare for a killer quake?

TERRY JAGERSON
How do you truly prepare for enough injured to fill every emergency hospital bed in the free world?

NARRATOR
Tonight..."The Earthquake is Coming."

JUDY WOODRUFF
Good Evening.

Think about earthquakes and you think of California. But some seventy-five million Americans in thirty-two states live on or near active fault lines. In fact the greatest quake in U.S. history happened early in the nineteenth century—in Missouri, creating two lakes and altering the course of the Mississippi River.

For centuries, earthquakes have been the subject of superstition, myth and movies. But tonight's earthquake story is all too real.

Because before the end of this century, a major earthquake is in fact expected to hit California. It will affect millions of us, wherever we live. As producer Irv Drasnin reports, the earthquake is coming.

EARTHQUAKE REPORTS

U.S. Geological Survey: Good Morning. Thank you for calling the U.S. Geological Survey's earthquake information update. We have recoded 28 earthquakes in northern and central California larger than magnitude 1.0, occuring in the last 24 hours.

University of California Seismographic Station: The University of California Seismographic Station at Berkeley recorded a strong earthquake off the coast of California, northeast of Eureka.

We have recorded 31 earthquakes in northern and central California larger than magnitude 1.0 during the last 24 hours.

This earthquake is an aftershock of the magnitude 5.8 earthquake. The Berkeley magnitude for this event is 5.6 on the Richter scale. This earthquake was sharply felt in the Berkeley area and was felt widely throughout the San Francisco Bay Area.

The largest of these was a magnitude 4.4 earthquake...located southeast of Coalinga, California...This earthquake was located at Parkfield...This epicenter was located along the Calaveras Fault...was located approximately 20 kilometers northwest of Palm Springs. Magnitude for this event is 3.9 on the Richter scale.

ALLAN LINDH, U.S. Geological Survey
Take away the earthquakes, you take away the mountains, you take away the long, linear valleys that most of us live in. California would be a vastly less interesting place to live, and I'm not sure most of us would be here, were it not for the very interesting topography and the local climates that produces. And the beauty of this state is almost entirely due to the tectonic activity. You can't have one without the other.

I believe if you put the question of earthquakes to a vote in the state of California, and they had to choose between the beauty of the natural setting here, and the threat of earthquakes, they would vote for earthquakes. They would take the beautiful setting and take the risk that goes with it.

IRV DRASNIN

The risk is a natural disaster unlike any other in the nation's history; a disaster that can't be prevented or even predicted; a disaster that tells us something—not only about nature, but about human nature.

Californian #1: It's very pleasant here, and I wouldn't live any other place.

Irv Drasnin: The scientists say there's going to be a major earthquake in California. It's just a matter of time.

Californian #1: They've been saying that since the day I came here, in 1946, and I'm still waiting. So far, it hasn't happened. Don't believe everything the scientists tell you.

Californian #2: When one happens, you wait for the next one. You know, I mean like there was the one that not only knocked me out of bed at four o'clock in the morning, but I crawled on my hands and knees. And I got under a table because I was waiting for a couple more.

Irv Drasnin: I mean, why do you live here?

Californian #2: I love it. I love California. I just spent 2 1/2 years in New York.

IRV DRASNIN
No one knows exactly what a major earthquake would do in California, an earthquake happening in the wrong place at the wrong time. It can only be imagined, as in these exercises.

Irv Drasnin: How do you feel about earthquakes?

Californian #3: Well, I feel all right about it. I'll tell you, I have a lot of fun during an earthquake. My refrigerator at one time was in the living room, and I was in the bedroom—you see what I mean by that? The earthquake put it over there. And it's very handy. I open it right by my bed, and I eat and have a good time. Yeah, earthquakes are not bad.

IRV DRASNIN
The odds aren't good. A better than fifty-fifty chance that within the next thirty years Californians will be climbing from the wreckage of a devastating earthquake.

Californian #4: I'm very much concerned. In fact, my daughter thinks that we're going to roll into the sea. Los Angeles. In other words, it's coming up the ... my daughter really feels ... in other words, she thinks Los Angeles is going into the sea.

Irv Drasnin: How do you feel about it?

Californian #4: Uhh well, I can't swim.

IRV DRASNIN
Precisely where and when a great earthquake will strike remains a mystery. But not why. In California, the biggest reason is the San Andreas Fault—650 miles long and up to a mile wide. It dominates the landscape and divides the state along two constantly shifting plates of the earth's surface.

Dr. Kerry Sieh,
California Institute of
Technology: And here in California, the North America Plate, which begins just over the mountains here, in the Mohave Desert, and runs all the way to Iceland, is moving southeastward this way, ralative to the Pacific plate, which goes all the way from where we're standing, here, the San Andreas Fault, over the moutains, all the way to just offshore Japan, offshore New Zealand. And uh, those plates are moving every year horizontally, relative to each other, and they're moving at about two inches a year. And the faults have a...as the boundary breaks, the fractures have a certain amount of strength, they can stand the accumulation of a certain amount of strain and movement. But eventually that strength is overcome, and they snap. And the snapping is what generates the waves in the earth that produce the earthquake.

Irv Drasnin: Is it inevitable that there will be a catastrophic earthquake in California, sooner or later?

Dr. Sieh: Yeah. It's inevitable.

Irv Drasnin: No doubt about it?

Dr. Sieh: No doubt in my mind. I'd be willing to bet you.

IRV DRASIN
Scientifically, it's hardly a gamble. It's happened before. A great earthquake that destroyed San Francisco in 1906. It's estimated to have been an 8.3 on the Richter scale, which measures an earthquake's size and destructive energy, the same size earthquake they say will inevitably happen again--in California.

Irv Drasnin: Is there any reason to doubt the scientists who say that the big quake in California within the next twenty to thirty years is inevitable?

Richard Eisner,
Bay Area Earthquake
Preparedness Project: There's no reason to doubt them at all. In fact, we have a history in the last century of recurring earthquakes, major earthquakes, great earthquakes. We're only had one in this century, in 1906, but there's no reason to believe that the pattern of the last century won't be repeated.

Irv Drasnin: Is it fair to say we're running out of time?

Richard Eisner: Well, every year we go without an earthquake we're getting closer to the next major catastrophic earthquake.

IRV DRASNIN
Richard Eisner is in charge of earthquake awareness for the San Francisco Bay area. And sitting in the football stadium, at the University of California, in Berkeley, he can't get any closer to a possible catastrophe.

Irv Drasin: Where we're sitting, in the football stadium at Berkeley, how far are we from the nearest, biggest fault?

Richard Eisner: About two feet. We are on the trace of the Hayward Fault, which runs from Albany down through Oakland, down to the East Bay—probably the most populated part of the Bay area.

IRV DRASNIN
The population along the Hayward Fault, directly across the Bay from San Francisco, has grown to more than two million people. The Hayward lacks the reputation of the nearby San Andreas, but not its potential for destruction. Geologists consider it one of the most dangerous faults in California, if not the world, where even a 6.5 earthquake would be devastating.

Irv Drasnin: In your view as an architect, an urban planner, have we acted wisely in the face of this threat of a catastropic earthquake?

Richard Eisner: (laughs) That's the question that's embarrassing to answer, because in the last eighty or so years, until very recently, we essentially ignored the threat of earthquakes in the Bay area. We've built on sites that are directly on top of the fault, we've built in areas where we'd expect extremely violent groundshaking, subsidence, ground failure, liquifaction. A lot of our lifelines, such as bridges and freeways are built on areas that we would expect to have ground failure. In one case, we built an emergency operation center on the fault trace. That's a center that's responsible for the emergency broadcast system, for communicating to the public, after an event. It was built to be blast-proof, it was built in the fifties as a part of the Civil Defense Program. but it will be isolated, at best, after a major earthquake.

Irv Drasnin: What about hospitals, and medical care?

Richard Eisner: Well, there used to be a joke that if you want to find the Hayward Fault, you draw a line between the hospitals and the East Bay. And we do have a number of hospitals that are built very close to the fault. We expect a number of them to be subject to damage, and potentially be victims themselves, not being able to care for the patients that would be coming in from the surrounding communities.

IRV DRASNIN
There are four hospitals, thirty schools, a power station, even a resort hotel on or near the fault line. But in a great earthquake, medical care becomes a critical issue on either side of the Bay.

DR. MICHAEL CALLAHAM, University of California San Francisco Medical Center
Most hospitals in the Bay area are not expected to survive intact in an earthquake, and will be either partially or totally incapacitated, will physically fall down, as we saw happen in Mexico City.

IRV DRASNIN
Dr. Michael Callaham is Chief of Emergency Medicine at the University of California Hospital, in San Francisco. He'd be among the first to respond to the needs of thousands injured in an earthquake.

Irv Drasnin: If the earthquake were to hit, tomorrow or next year, would you be ready for it? Could you deal with it?

Dr. Callaham: In the sense of being able to provide the usual standard, quality of care, that the average American citizen expects, absolutely not, and we never will be.

Irv Drasnin: What do you need that you don't have, to deal with the aftereffects of a catastrophic earthquake in the Bay area?

Dr. Callaham: Well, just about everything, because basically the whole substructure of modern medicine is going to disappear. I mean, we count on first of all having a physically intact building, of having electricity, of having natural gas piped in, of having fresh, unlimited water, and having a transportation system that will bring patients to us. We also count on supplies. Very few hospitals find it economically possible to store, say, a week's worth of supplies on the premises. And, as a result, we have about one day's worth of supplies in the hospital. And the rest are stored elsewhere, somewhere on the other side of the city, where we probably wouldn't be able to get to them in an earthquake. So, we're probably going to run out of all those things.

Irv Drasnin: And what might the consequences be?

Dr. Callaham: Well, the consequences will be that we just won't, we'll have to improvise, we won't be practising the standard of medicine that we ordinarily do. It's going to be a battlefield condition, but we'll make do, you know, we'll be back to the old movie cliche' of ripping up clothes, you know, tying on bandages, pieces of cloth, that sort of thing. And some people just aren't going to get treated adequately.

IRV DRASNIN
In the days immediately after an 8-point earthquake in the Bay area, as many as forty-four thousand people would require hospital care. Up to eleven-thousand could be killed. Those estimates could be high or low. Lifelines would be disrupted if not broken. Bridges are expected to survive, but not their approaches, making them unusable. There will be widespread damage to freeways, power lines and communications. The San Francisco Airport, built on landfill next to the Bay, will be closed for several weeks. The runways are expected to break, or sink into the weakened ground.

A federal assessment is pessimistic, calling the nation unprepared for a catastrophic earthquake in California, saying the response to it will quickly become disorganized, ineffective.

Richard Eisner: **We know inevitably we're going to have recurrences of major earthquake in the Bay area, and that people are going to be killed. And unless we find out beforehand what the problems are, and solve the problems, strengthen the buildings, we're essentially dooming a significant population of the Bay area to death and injury. And that's irresponsible.**

Irv Drasnin: **Why? Why aren't we doing something about it?**

Richard Eisner: **I think for two reasons. One we avoid the fact of the earthquake threat. All of us do, individually, businesses do, government does. And secondly, there's a concern just for the magnitude of the problem. Can we afford to strengthen these buildings? I would turn that question around and say, can we afford not to? And my answer is, we can't we cannot afford to leave these hazardous buildings in place.**

IRV DRASNIN
It's been said that earthquakes don't kill people, that buildings do. All of San Francisco is vulnerable, but some parts of the city are even more endangered than others. One is Chinatown, where many of the Bay area's thousands of unreinforced brick buildings could collapse in a big earthquake. Even if they didn't, it's likely their stone parapets would crash to the crowded streets below.

IRV DRASNIN (Continued)
Some buildings are vulnerable not because of how they're built, but where. The heavily used financial district is also on landfill, and subject to ground failure if the earthquake is big enough.

The same is true for this fashionable residential neighborhood on the Bay's edge, the Marina, where the landfill supporting these joggers includes debris from the Great Quake of 1906. It could be a reminder, or an omen.

Richard Eisner: **If we have a recurrence of a 1906-type earthquake, a great earthquake in the Bay area, or even an 1868 earthquake on the Hayward Fault, the recovery from that event would be decades.**

Irv Drasnin: **Decades.**

Richard Eisner: **Decades.**

Irv Drasnin: **We're talking about billions of dollars.**

Richard Eisner: **We're talking about forty-four billions of dollars.**

Irv Drasnin: **We're talking about the loss of thousands of lives.**

Richard Eisner: **Yes. And the forty-four billion dollar figure is just structural damage. It's not loss of income, it's not business disruption, it's just physical damage to buildings.**

IRV DRASNIN
Earthquake experts must contemplate the hidden power of nature, and consider the consequences. It's human nature, to take another view, hardly aware that you might be fishing at the very spot where the San Andreas Fault comes ashore, at Mussel Rock, in a suburb just south of San Francisco.

If there's a community that typifies the promise and peril of life along the faultline, it's Daly City. The promise, for some eighty-thousand people on these suburban streets, is an affordable home. No matter that thirty years ago a frightening earthquake shook this area, or that some of these houses have been condemned.

Irv Drasnin: Is it ever on your mind that the San Andreas Fault comes into the coast, very close to you?

Daly City Man #1: Umm, all the time, yeah. Of course, we got the cliff, there, and that's pretty scary. I thought about that the last... it's a pretty good drop. A lot of, a lot of land could slide right out of here, you know.

IRV DRASNIN
But even on this cliff, it's life and business-as-usual for the real estate agent.

Irv Drasnin: When people come to look at this house, are they aware that the San Andreas Fault comes in from the coast in this area?

Real Estate Agent: Yes, uhhh, I'd say a large percentage of the people are aware of it. They do ask, "What about the slides?" You can look out and see, there is an erosion problem in some of the cliffs out here. They do, they're very concerned. They almost, some people want a guarantee that, "Gee, if I buy this property, is it going to be here in ten, twenty years? Am I going to be able to sell it?"

Irv Drasnin: What would persuade you to live right here?

House Hunters: The view.

Irv Drasnin: Are you aware of what you're standing on right now?

House Hunter #1: We weren't when we looked at the other house, but we are now.

Irv Drasnin: You know the San Andreas Fault comes in, right over here?

House Hunters: Yeah. Uh-huh.

Irv Drasnin: If people don't know the San Andreas Fault is right outside this window, do you tell them?

Real Estate Agent: You have to. If they write up an offer, you have to disclose that information to them. Anything that would change somebody's mind about purchasing that property, you have to disclose to them. If you don't you can be in a hell of a lot of trouble.

Irv Drasnin: Did you ask the real estate agent about any of this?

House Hunter #1: No. Nothing, nothing. From the place over there—did you take a look in there?— you find out that you cannot see this.

Irv Drasnin: Did she say anything about these houses being on the San Andreas Fault?

House Hunter: No. Not a word.

Irv Drasnin: We just talked to a couple who had just seen this house, and they said they didn't know the San Andreas Fault was right outside here.

Real Estate Agent: Oh! They didn't? Well, we have so many people coming through here, it's impossible to really talk to everyone.

IRV DRASNIN
This neighborhood is known officially as a geological hazard study zone, Landslide Site 26.

But not everyone knows about his neighbor, the San Andras Fault, a subject that wouldn't come up at a Sunday brunch, unless you asked.

Irv Drasnin: Have you every heard of the San Andreas Fault?

Man at brunch: Yeah. I heard about it.

Irv Drasnin: Did you know that you were living right on top of it?

Woman at Brunch: Are we?

Man at Brunch: (laughter) Yeah. That's what he said. We are. But if we knew that, we wouldn't even have bought this house.

Irv Drasnin: How do you feel about that?

Woman at Brunch: Well, we own this property now. If something happens, its the will of God. That's how I look at it.

Real Estate Agent: You know, you can tell somebody that we're going to lose part of the peninsula, and I don't think anyone's going to pack up and move.

Irv Drasnin: Why not?

Real Estate Agent: People are that way, you know. they hear so much stuff, they just ...

Irv Drasnin: It's just part of being a Californian?

Real Estate Agent: That is. It's shaker city. And you know, people say, "well, yes but——you get a view, I like the view. There's a possibility that an earthquake might not happen." And, "maybe I'll live here ten years and sell it to somebody else, and get out."

EARTHQUAKE REPORTS

Speaker #1: We have recorded 359 earthquakes in northern and central California larger than magnitude 1 during the last twenty-four hours...

Speaker #2: This epicenter was located about 4 miles east of Berkeley...

Speaker #3: The Berkeley magnitude for this event is 4.0 on the Richter scale...

Speaker #1: We have recorded a magnitude of 5.3. This earthquake was located approximately 20 kilometers northeast of San Jose...

IRV DRASNIN
From Daly City, 400 miles south to San Bernardino, there's no place to go to escape the central fact of California's geologic life. The San Andreas

IRV DRASNIN (Continued)
and other faults cut through and around the state's most significant centers of population...and, of industry, like Silicon Valley, 50 miles south of San Francisco.

What happens in Silicon Valley is felt far beyond California. These companies are on the leading edge of high-tech research and development. And on the brink of disaster in the event of a big enough earthquake. They're making everything here from microchips to space satellites, accounting for a major share of the country's third largest industry and its three hundred billion dollars in worldwide sales. But they haven't made buildings to withstand the shock waves of even a good-sized quake. That's one of the things that concerns Jim Berkland, the local county geologist, who has made it his job to think ahead about earthquakes.

Irv Drasnin: But if and when it happens...

Jim Berkland, Santa Clara County Geologist: Ohh, don't say if. Never say if.

Irv Drasnin: It's going to happen?

Jim Berkland: Absolutely!

Irv Drasnin: No question about it.

Jim Berkland: No question.

Irv Drasnin: When it happens...

Jim Berkland: Yes.

Irv Drasnin: ...how vulnerable is Silicon Valley to a catastrophic earthquake?

Jim Berkland: We haven't really had a test. The 6.2 we had on April 24 two years ago was child's plan compared to an 8.2— like, 1/1000 of the energy involved. We would have to have 1,000 of those 6.2s to equal one 8.2. I know one of the question marks that structural engineers talk to me about are the tilt-up structures, which are almost a local phenomenon, where they pour the walls on the ground flat, they prop them up and tie them together. And then they slap the roof on. Now, if all of these are not tied very carefully together with steel, they're going to be subject to a lot of distress, and with the possibility of the walls moving outward and the roofs coming down.

Irv Drasnin: **Those buildings could collapse?**

Jim Berkland: **They could.**

Irv Drasnin: **How typical is that of buildings in Silicon Valley?**

Jim Berkland: **There are thousands of them.**

IRV DRASNIN
What's in and around those buildings is the unseen danger for Silicon Valley and everyone within miles of it. The gases, chemicals and other harmful materials whose release could be damaging for years to come.

RICHARD EISNER
Those buildings that contain hazardous materials or hazardous processes would be spilling those materials. They have a problem now with underground storage tanks that are leaking into the groundwater. And you'd expect to see some of those tanks literally floating out of the ground, because of high groundwater, or being ruptured and contaminating the drinking water to a number of South Bay communities.

JIM BERKLAND
We have so many buried tanks, old gas tanks, natural gas lines, reservoirs for wastes from the various Silicon Valley companies. And to me they're like a lot of land mines, waiting for a seismic footprint. In many cases, we're not sure what happens when the contents merge. Maybe they're bad enough by themselves, and when they merge, what are we up against?

IRV DRASNIN
What Silicon Valley is up against is a landscape that includes at least two major fault lines. Along with prosperity has come the realization of what a big enough earthquake could do—even a 6.2, like the one in 1984, is an earthquake that people near here will not soon forget.

Ken Santos,
Silicon Valley Resident: **Minutes after that earthquake, this road was just jammed with traffic. We had about 2,000 people trying to get out of here. We knew something bad had happened over at United Technology. The IT Company that hauls**

Ken Santos (Continued) **hazardous waste materials—there was a steady stream of their trucks going in and out of here, both liquid and solid waste trucks. We're up in this canyon just above them. We're actully above United Technology. And in the past, whenever they've had explosions or chemical leaks of any kind, if the conditions are right, the air currents carry everything right up this canyon, just like it was in a chimney. And the complex itself, where they store their hazardous materials is right on the Calaveras Fault.**

Irv Drasnin: **Right on the fault?**

Ken Santos: **Right on it.**

IRV DRASNIN
United Technology Corporation makes and tests fuel for space rockets and nuclear missiles, and admits the earthquake caused almost three million dollars damage. UTC denies that any lives were endangered, but the possibility is not lost on Ken Santos.

Ken Santos: **I thought I knew what an earthquake was, but after what we went through, I had no idea, really, what an earthquake could co. The groaning that came up from the bowels of the earth, and the shaking...**

Irv Drasnin: **How long have you lived here?**

Ken Santos: **I've been here for forty years.**

Irv Drasnin: **Why do you stay?**

Ken Santos: **We aren't. We're going to move if we can.**

IRV DRASNIN
In California, there are few places to move to, that aren't potential earthquake zones. And where ever you go in California, people have earthquake stories to tell.

Man: **I was over there by the rose bush and she was in here. And the ground started going up and**

Man (Continued): down, just like on a trampoline. And she couldn't get over to me, and I couldn't get over to her. It was that bad.

Woman: It makes you seasick. Everything moves.

Man: Yeah. The people who were working in the park over there, and they all yelled, "Earthquake! Earthquake!"

Man #2: I was in an apartment with three other GIs, we just got out of the service, and when we woke up under that earthquake condition, we all thought we were in Viet Nam with mortars coming in, and we actually woke up yelling, "Incoming!" And by the time I really woke up, I was down the stairs and outside the building.

Man #3: I was at home, and it shook to where the water actually splashed out of the swimming pool, I mean large amounts of water...

Man #4: I said, well, it's going to go down, but it came out just like this, just like an accordian! The building! And the ground... I had a very hard problem keeping my equilibrium—I'd go like this. The ground was going just like this.

Jim Berkland: I felt this big bang, and went dashing for the door, figuring there was an explosion. And then I saw the neighbor's five acres just undulating and rolling like a choppy sea, with the waves maybe a foot high.

Peggy Donaldson, Real Estate Agent: There was a lot of noise. It was almost like a freight train coming down the hall. Things were flying. You could not get across the floor, because the floor was rolling. There was no way out. You basically had to stay where you were, and just wait until it stopped. And pray that it stopped.

Daly City Man: One time, I panicked. This was when I was living in the city at the time, and, you know, I just panicked. We were up on the third floor and I was just--"Let's get out of here!" But now, you just sort of ride 'em out. Because there's really nothing you can do. Go outside, inside you just have to stay with it.

IRV DRASNIN
Not every earthquake can be felt, but almost forty thousand a year are recorded in California, and seismic activity is increasing. So is the attention being given it by government experts like Allan Lindh.

ALLAN LINDH
A great earthquake on the San Andreas Fault in California is a very real threat, and a threat that the people of California should be aware of and should be preparing for.

IRV DRASNIN
Lindh, and colleague Bill Bakun, are geophsicists who are all too aware of what isn't yet known about earthquakes, and aware also, that what we don't know could hurt us.

WILLIAM BAKUN, U.S. Geological Survey
If you take a look at the fault map of California it's covered with lines, and there are many other faults that we don't yet know about. Earthquakes that occur on these faults, surprise us. We've been surprised a few times in the past few years, and we'll be surprised again. There will always be unexpected earthquakes in California, because that's a very complicated piece of real estate.

IRV DRASNIN
On the morning of May 2, 1983, no one knew there was a major active fault near the central California town of Coalinga. By 4:45 that afternoon, everyone knew.

PEGGY DONALDSON
It looked like someone had dropped bomb on Coalinga. We had a number of brick buildings downtown. And those brick buildings were pretty well destroyed. There were bricks all the way across the street. There was a fire going, one of our businesses, a restaurant, caught on fire. It burned it and the jewelry store, next door. So, it was really, it was bad. It looked like a bomb had struck.

IRV DRASNIN
Peggy Donaldson is a real estate agent who recalls the day that put Coalinga on the map.

PEGGY DONALDSON
And I believe myself, as well as probably most people in Coalinga, kind of went into shock. And I believe we, we basically stayed in that shock for months, perhaps even a year or two. I find myself now, if a noise is made suddenly, I jump. You know, because I'm wondering, is it another quake?

IRV DRASNIN
On Peggy Donaldson's block, every house but one was destroyed. And the rebuilding isn't finished yet. One of every three homes in Coalinga was severely damaged, twenty-six businesses lost. In all, damage was thirty-one million dollars, and more than 200 people were injured. The earthquake, a 6.7, lasted six seconds.

PEGGY DONALDSON
So it took a little recovery time. But I've actually had clients call, or customers call, and say, "I'm thinking about moving to Coalinga. I need a little excitement in my life."

IRV DRASNIN
Try as they might to put it behind them, the people of Coalinga also discovered something geophysicists do know: it doesn't take an 8-point earthquake to be destructive.

There's no season for earthquakes, and usually no warning. That makes the prediction of earthquakes the most uncertain science of all. Yet California is being wired, measured and monitored, in search of an earthquake about to happen. The scientists think they're found one, halfway between San Francisco and Los Angeles: Parkfield, a sparsely populated farm community with a one-room schoolhouse, where one of the teacher's lessons is about Parkfield's remarkable history of earthquakes.

Duane Hamman, Teacher: **We had an earthquake in 1857, 1881, 1901, 1922. In 1922, uhh, to '34 it moved its schedule up a bit. It came in 12 years instead of the usual 22. Then from '34 it went up to '66, and therefore it averages out to that neat 20,**

Duane Hamman (Continued): 22-year cycle again. So, the reason for studying Parkfield is you have something here to study.

Irv Drasnin: It sounds to me like that next earthquake is coming pretty soon.

Duane Hamman: Yeah, it didn't move its 12-year cycle, so we're looking at it, just logically, '88 would fit the pattern.

IRV DRASNIN
Duane Hamman is doing more than teaching these days. Three times a week, he goes to work in a pickup truck, driving right past the San Andreas Fault.

In this Valley are about 170 people, 18 seismograpsh, 8 creep meters, and a laser gun.

Hamman is looking for any sign an earthquake is on the way. Any one of 17 reflectors will indicate if the earth has moved even 1/15 of an inch. But geophysicists still aren't sure if they have the right answers.

WILLIAM BAKUN
The fact that we predicted an earthquake in Parkfield is really sort of an accident. We don't know how to predict earthquakes yet. That's what we're trying to find out.

IRV DRASNIN
That's what most experts say—the conventional wisdom. It's not what all earthquake-watchers are saying, including Jim Berkland, a geologist, whose unconventional methods, he says, bring results.

Irv Drasnin: How successful are you at predicting earthquakes?

Jim Berkland: Well, the latest count as of the end of February was 197 out of 237, and that was an 83% average. Now, I just blew one last week. I call Cal Tech, expecting a southern California earthquake, of moderate—3 to 5—and it didn't happen. Uhhmm...the dogs fooled me that time.

IRV DRASNIN
The dogs that fooled him are in the newspapers' missing pets column, which Berkland believes is an important clue for prediction. He says animals act strangely before an earthquake, and often run away. The theory may be unorthodox, but it's not unheard of.

Jim Berkland: We've got 12 lost, that's counting 2 puppies as one, because puppies go off together. Uhh, and if it's a mother dog and a puppy, I count that as one. But we have 12 lost and 6 found for a total of 18—that's one of the lower numbers.

Irv Drasnin: How many dogs and cats have to be missing before you suspect something?

Jim Berkland: I do have a threshold level. For cats, that level is 6—because the normal is 3 or 4. And for dogs, it's 40. Now, before a 6.2, we had 41 missing. Before a 5.3 here, we had over 50 missing dogs, this year.

Irv Drasnin: The incidence of unusual animal behavior around the time of an earthquake can't be just coincidental?

Jim Berkland: Not in my book. I used to think so. But I've had so many personal experiences, and so many responses from pet owners and veterinarians and pet hospitals, that it can't be accidental.

DR. JIM STILES, Veterinarian
There are days when all these delightful cats come in, and every one of them is mad, or tries to scratch, or bite, or hiss. And, whenever I see a day like that, when practically all of them are...that means to me there's something going on in the environment that's affecting more than just one cat. When it's affecting several cats, then there's something big out there.

IRV DRASNIN
Jim Stiles is a veterinarian who says, when it comes to earthquakes, cats, at least, should be taken seriously-based not only on their behavior, but on signs of a specific illness.

DR. JIM STILES
There's a urological syndrom called feline urological syndrome where crystals are produced in the bladder. It's triggered by stress. Nobody is really sure what causes it. And every time we see a rash of them—4, 5 or 6—in a very short period of time, an earthquake is imminent.

JIM BERKLAND
When you see something like this, you have to say, "Something's going on."

IRV DRASNIN
Berkland also claims that studies of the sun, the moon and the tides point to periods during which the world is most likely to experience earthquakes. He calls them "seismic windows."

Irv Drasnin: Jim, what do you see for this seismic window that's coming up this week?

Jim Berkland: Okay. Between 23 and the 30 of April, I'm 75% confident that we're going to have a 3.5 to 5.5 magnitude quake, within 70 miles of San Jose.

IRV DRASNIN
A 3.5 is the smallest earthquake that Berkland predicts. And this one, he believes, will strike close to home. It did.

EARTHQUAKE REPORT
A magnitude 3.5 earthquake occurred yesterday morning. This earthquake was located approximately 24 kilometers northeast of San Jose.

Jim Berkland: Also, somewhere in the world, I fully expect at the same confidence level—75%—that we're going to have a 7.0 or better. A major quake.

EARTHQUAKE REPORT
A major earthquake occurred near the southern coast of Mexico. The magnitude was computed at 7.0 on the Richter scale.

IRV DRASNIN
Berkland was right again. But his predictions and his methods have not satisfied his critics.

WILLIAM BUKAN
People at the Geological Survey have tried to evaluate those claims, and come up with quite different numbers. We really, I don't think have a particular reason to disagree with him. I think we're open-minded in trying to find ways to do this. But I think the concensus was, for the people who looked carefully at that, that he did a little bit, he didn't quite do as well as he would have done if he flipped a coin.

JIM BERKLAND
They would say, "Oh, he's merely matching two random series of events. It's little bit better than reading tea leaves." "Berkland's not a scientist—he's an enthusiast." "Uhh, we don't discuss Berkland, and his theory. We have our own theory about Berkland."

ALLAN LINDH
It would be very useful if Jim would come forward and publish the data on alignment of planets, or dogs and cats, or anything else. Just in the ordinary way he publishes papers on geologic mapping. Jim's a geologist, he knows all about publishing in journals. He knows what the rules of the game are. And to my knowledge, he still chooses to ignore the rules of the game and conduct his research in the public press.

IRV DRASNIN
Along with his predictions, what Jim Berkland has published is a poem, an ode to official sceptics.

Jim Berkland:

The moon was over Katmandu.
The cats were fleeing two-by-two
The fleas were also right behind
Along with beasts of every kind.

A catalogue of what I'd seen
I brought before the King and Queen.
The jester made the droll remark
That frightened ducks say "Quake-Quake-Quake."
Then laughter shook the noble hall
Where plans continued for a ball.

The Regents moved to spurn my plea.
The town moved then to 8.3.

IRV DRASNIN
It's the view of many geologists that moving to an 8.3 means taking the road to southern California in the direction of San Bernardino.

To the relief of this country's one million people, and to the millions more in Los Angeles just forty miles west of here, the southern San Andreas hasn't moved dramatically in 130 years. But a catastrophic earthquake occurs here about every 145 years. That's the reason this is considered the most likely place for the next great earthquake.

Schoolteacher: **We are simulating the San Andreas Fault. When there is pressure exerted on these two faultlines, we have an earthquake. Pressure. Pressure. Slip.**

IRV DRASNIN
With the San Andreas Fault no more than a few hundred yards away, a school playground becomes a training ground for learning to live with earthquakes. Sixth graders are being taught what an earthquake might do. And what to do when it happens.

Irv Drasnin: **Do you ever play around here, up on that fault?**

Child # 1: **Yeah. We ride our skateboards in the faultline.**

Irv Drasnin: **Is that a good place to ride a skateboard?**

Child #2: Yeah. Great.

Irv Drasnin: What make it good?

Child #1: It's just rounded off in the bottom. Just something to do after school.

Irv Drasnin: Have you ever felt earthquakes around here?

Children: Yeahp!

Irv Drasnin: What do they feel like?

Child #3: Like a boulder moving under your feet.

Child #4: Just like the room sways and stuff. A kinda big gigantic swing.

Child #3: Pictures fall down off the wall.

School principal: Two injured—who are they? Steele, Edmund, and Laura Huxley. Okay, okay, we'll work something out. What we want to do is get each one of the children out, and your supplies out. So if you'll have your aide come out first, hand her the supplies and then designate the children to come out. If you'll come out after we've evacuated the injured.

IRV DRASNIN
Along with geography and arithmetic, in southern California the earthquake response drill is now part of the curriculum.

Irv Drasnin: Why are you doing all of this today?

Child #1: So then we could be prepared for a real earthquake. And so then we would know what to do before, during and after an earthquake.

Irv Drasnin: Are you prepared?

Children: Yes.

Irv Drasnin: Do you every worry about an earthquake?

Children: No

Child #2: Yes

Child #3: Yeah, sometimes.

Child #4: If we go through this, we won't be worried.

IRV DRASNIN
Psychological preparation is also important for adjusting to an earthquake's shock, and aftershock.

Child: It's kinda scary, 'cause you don't get to see everybody when an earthquake is going on. Like it shakes, and you can't like go outside to make sure everybody's okay.

Teacher: How you doing, okay? Good. Everything's going to be fine so you just relax. Okay? Everything's going to be fine. Let's get a blanket, another one to cover it. Good for you. Here we go. Good boy. Everything will be fine. Here we go. There. Okay?

TERRY JAGERSON, Deputy Sheriff, San Bernardino County
So it's a terrible tragedy, uh, it's a tragedy that is second in tragedies that have occurred in this country. The first is the Civil War, and then by far, this will be the second worst that's ever occurred.

IRV DRASNIN
Terry Jagerson of the San Bernardino County Sheriff's Department, is in charge of emergency services. His emergency planning is dominated by the one central fact he can neither escape nor forget, even at twelve thousand feet.

TERRY JAGERSON
In L.A., all these mountains are a large part of the San Andreas Fault geology. And see, right out in here, that is the San Andreas Fault. There's a little ridge lying there, about a half a mile from us now.

IRV DRASNIN
The city of San Bernardino sits atop two major faults: the San Andreas, and the San Jacinto. And the city's major freeway interchange, used by two hundred thousand cars a day, straddles the San Jacinto.

TERRY JAGERSON
I think that there's a possibility that these may go down during an earthquake. Because we have maybe twenty primary pillars upon which those things stand, and any one of which falls, it looks like it would, uh, eliminate transportation. You wouldn't be able to have traffic go in or out on these thoroughfares.

IRV DRASNIN
A less obvious danger looms in the surrounding terrain, and has caused Jagerson to say living here is like sitting on a hydrogen bomb.

TERRY JAGERSON
One of the things that's going to happen is that the petroleum in the natural gas lines, which are under high pressure, are going to burst, creating a large cloud of gas. And we're told that that will be so dense that—it can't explode 'cause there's no oxygen in it—but as they diffuse it will become very volatile and could explode.

IRV DRASNIN
From this perspective, in the foothills, it might not appear as life-threatening. But this is one of the fastest growing counties in America, a region already in the midst of a population explosion.

TERRY JAGERSON
You can see, right up there next to the San Andreas Fault, right next to it there's a new tract of homes going in. Look at all these houses! I mean there's tracts going in all over here. There's a new tract. There's

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TERRY JAGERSON (Continued)
a new tract. There's one right in front of us, there's two over there, there's three over there. It's just an amazing growth time that we're having. This area is growing, in spite of the threat. They're indicating sixty billion dollars in structural damage, fifteen thousand dead and fifty-five thousand injured. And to try to take that into concept, if we took those that needed hospitals and put them into the emergency beds, and put all of them into emergency hospital beds, it would fill every hospital bed in the free world.

Terry Jagerson: **How do you truly prepare for enough injured to fill every emergency hospital bed in the free world? That's hard to do. How do you prepare for the blood that's going to be necessary, and uh, the infrastructure needs, like water and power and sanitary conditions that have to be done, the burying of the dead is going to be a problem. So, we're being better and better prepared, but I don't think we'll ever be totally prepared to respond to that. It's going to be like, how do you prepare for a nuclear war. I don't know if you can prepare for one, having it; you might prepare for preventing one.**

Irv Drasnin: **But you can't prevent an earthquake.**

Terry Jagerson: **And you can't prevent an earthquake. And it's coming. Every minute brings us one minute closer to that fact.**

EARTHQUAKE REPORTS

Speaker #1: **The University of California Seismographic Station at Berkeley recorded a strong earthquake...**

Speaker #2: **We have recorded 138 earthquakes larger than magnitude 1 during the last 24 hours...**

Speaker #1: **The University of California Seismographic Station at Berkeley...**

Speaker #3: **This earthquake is an aftershock of the...**

Speaker #1: **The Berkeley magnitude...**
etc.

IRV DRASNIN
It's speculation, if not fact, that an 8-point earthquake near here would cause strong ground shaking over an area 250 miles long and 100 miles wide—including all of metropolitan Los Angeles, and beyond—with consequences disastrous not only for California, but the nation, even the world. Los Angeles has become a world financial center, it's skyline dominated by banks, which depend on sophisticated computer systems, vulnerable to earthquakes. In this bank alone, 2 1/2 million checks a day are processed, worth some seventeen billion dollars. If the computers of L.A.'s banks are down for three days, it would affect the economy of California—and more.

DAVID HARRIS, Vice President, First Interstate Bank
We pay for our cars, we pay our mortgages, we pay our large debts to corporations that are not necessarily located here. All of those checks would be affected. All of those receipts would be affected. Likewise, the business in California that sell things to people outside the state would have no way of depositing and processing the incoming flow of checks. So, right way, we have a short-term interruption in the normal flow across the U.S. of check items.

IRV DRASNIN
If the bank's computers are down five days, the nation's economy would be affected. That's the estimate of the California Bankers Association, in a report David Harris helped to write.

DAVID HARRIS
The further we get behind, the further the ripple effect, financially, until we do reach the international clearings, that is, the wire transfers of major banks around the world, who are involved with supporting the import-export business. All those cars coming in from Japan, all those t.v. sets—those have to be paid for with international letters of credit. If the bank in Los Angeles is unable to issue letters of credit and follow up with good funds to the suppliers impeded in their ability to ship goods.

IRV DRASNIN
If the bank's computers are down seven days, it would affect the economy of the world, a possibility that can't be dismissed.

David Harris: **The question is, "How soon can be resume a more normal existence, both of individuals and small businesses and large businesses?" That's the key to the whole question, is the speed with which we can return to normalcy.**

Irv Drasnin: **Is there an answer to that question?**

David Harris: **Weeks. Weeks, perhaps months.**

IRV DRASNIN
The crippling effects of a great earthquake would also be felt by the nation's defense industry. At Air Force Plant 42 in nearby Palmdale, almost every Air Force plan since the 1960s has been built or tested less than a mile from the San Andreas Fault. Today, they're working on the secret Stealth bomber and the supersonic B-1. Throughout southern California, there are hundreds of defense contractors, doing forty-two bilion dollars a year in business vital to the nation's security. Most are located on or near a major faultline, a threat studied by Air Force Colonel Norman Neill.

Irv Drasnin: **You've surveyed some of our biggest defense contractors—Rockwell, Lockheed—are they ready for a big earthquake?**

Colonel Neill: **I don't think that many of our major defense contractors are ready for a catastrophic earthquake, just as most other businesses are not.**

Irv Drasnin: **Are we moving fast enough to prepare for that major earthquake the scientists say is coming?**

Colonel Neill: **Well, that a very key question and I think the answer is no.**

IRV DRASNIN
Neill's report calls it a distressing situation that would have a significant impact on the nation's military readiness. California companies account for half the government's missile and space business. In many cases, they are the only source for some of the country's most critical defense systems. And in the aftermath of a great earthquake, production delays could run from two to twenty eight months.

IRV DRASNIN (Continued)
When asked, several major contactors declined interviews about their vulnerability and preparation, a crucial issue, especially if the earthquake occurs in the near future.

Colonel Neill: I think if we had a major catastropic earthquake in the near term—within the next year or two—as our study showed, we'd have major damage to many of our contractor facilities and we'd have major program delays.

Irv Drasnin: It could be several months after a major earthquake before some of those manufacturers were back on line?

Colonel Neill: Could be.

Irv Drasnin: At this point, would it be fair to say that a major earthquake would have a serious impact on the nation's defense contractors?

Colonel Neill: It would have a serious impact on our defense contractor base, yes.

Irv Drasnin: And, therefore, on the nation's defenses?

Colonel Neill: Obviously.

Irv Drasnin: In the wake of a catastrophic earthquake, what kind of questions are going to be asked, if we're not ready, if we're not prepared?

Terry Jagerson: In the aftermath? By the congressional hearings that're going to come down and ask us, "Why didn't you do more?" I think that's the question—Why did't you do more? Why were we not better prepared? Why wasn't more money put into this kind of deal? Why wasn't there a greater sense of urgency to do more? What have we not done to prepare the average citizen for this?

IRV DRASNIN
For the average citizen, Palmdale as much as any other place symbolizes the unknown dangers that move beneath the surface of California's good life. It's a boom town of the 1980s, known as a model of growth, of the future. It's also known for the Palmdale bulge—the place where the San Andreas Fault mysteriously rose about a foot, in the 1960s. If that was a warning sign, it's been ignored.

But ready or not, the Great Earthquake is coming. It could happen in thirty years, or tomorrow; if not in our lifetimes, in our children's. How it will affect all of our lives, can only be guess. But, undeniably, it will.

EARTHQUAKE REPORTS

Speaker #1: There havebeen at least 5 magnitude 3.0 or larger earthquakes since the magnitude 5.3 that occurred this morning, and the level of aftershock activity has increased significantly.

Since Sunday morning, we have located more than 2100 earthquakes larger than magnitude 1 in this region, that are foreshocks and aftershocks of the magnitude 6.0 earthquake that occured on Monday.

JUDY WOODRUFF
A final note about our fear of earthquakes...

It has been eighty years since the Great San Francisco quake. However, now experts have discovered that the official death toll given by the city—478 killed—was in fact five times higher. More than two thousand people perished.

Why the cover-up? One theory is that officials conspired to downplay the death toll for fear that Eastern businessmen would be afraid ever again to invest in a city so vulnerable to earthquakes.

Please join us again for FRONTLINE. I'm Judy Woodruff. Goodnight.

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with JUDY WOODRUFF

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